How effective was helicopter sluicing as a rockfall remediation method following the 2016 Kaikōura earthquake?

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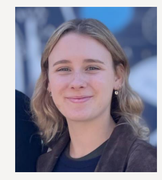


CONTEXT:

- Coseismic landslides during the 2016 Kaikōura earthquake significantly affected road and rail infrastructure, with urgent remediation required to restore the nationally strategic transport links (Robinson et al., 2018).
- **Large-scale helicopter sluicing was used to remove loose debris from earthquake-damaged slopes, to varying degrees of success** (Green & Finland, 2019).
- Heli-sluicing is a novel approach to landslide mitigation globally but was used extensively post-earthquake with up to **220 million litres of seawater dropped on more than 40 coastal landslides** (Green & Finland, 2019).
- Despite its widespread use in the earthquake response, little has been published on the approach, effectiveness, and cost-benefit of heli-sluicing coseismic landslides.

OBJECTIVES:

1. **Which landslides** along the Main North Line Railway and State Highway 1 **were sluiced**, and how did the use of sluicing vary spatially and in magnitude following the earthquake?
2. **Under what conditions** was sluicing most effective and **what is considered successful**?
3. **Have post-earthquake rockfall rates evolved differently** depending on whether a landslide was sluiced or not?

METHODS:

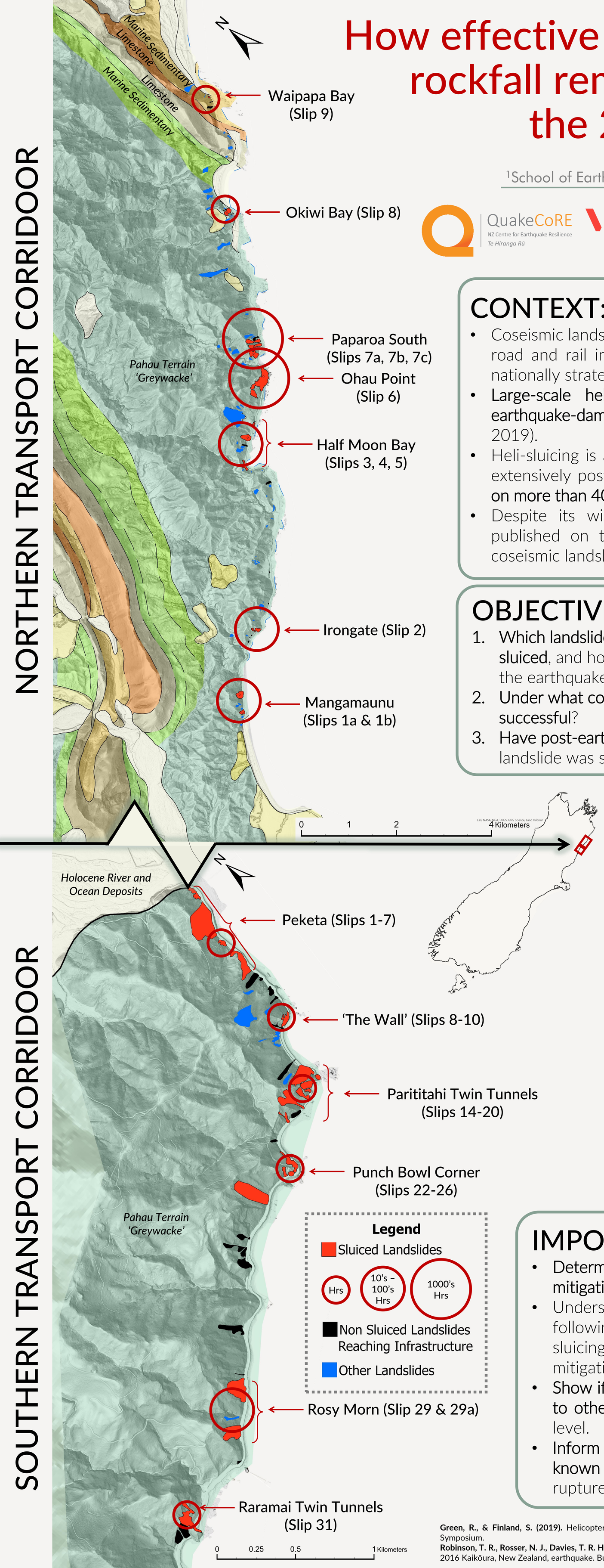
Landslide Mapping: Use GIS to create a high-resolution landslide inventory along the northern and southern transport corridors to understand the spatial distribution of sluiced and non-sluiced landslides.

Fieldwork: To categorise the geology and geomorphology of sluiced and non-sluiced landslides.

Data Analysis: Use the multi-year spatial and temporal dataset of rockfall activity along the transport corridor (FULCRUM dataset) to analyse the evolution of sluiced and non-sluiced landslides, factoring in installed mitigation methods. Overlay rainfall data from subsequent cyclone events to analyse the effect of natural rainfall vs sluicing on landslide source zones.

IMPORTANCE OF FINDINGS:

- Determining whether and when sluicing is an effective post-earthquake mitigation tool.
- Understanding how sluicing has affected rockfall rates in the years following the Kaikōura earthquake to evolve our understanding of how sluicing slopes performs relative to other mitigation techniques or no mitigation techniques.
- **Show if sluicing can accelerate post-earthquake rockfall activity compared to other techniques**, and when/if that rate is reduced to an acceptable level.
- **Inform decision makes on the use of sluicing in the response to other known earthquake hazards** such as an Alpine Fault or Wellington Fault rupture.



Green, R., & Finland, S. (2019). Helicopter Sluicing for Rockfall Risk mitigation in response to the 2016 Kaikōura Earthquake. Prepared for the 70th Highway Geology Symposium.
Robinson, T. R., Rosser, N. J., Davies, T. R. H., Wilson, T. M., & Orchiston, C. (2018). Near-real-time modelling of landslide impacts to inform rapid response; an example from the 2016 Kaikōura, New Zealand, earthquake. Bulletin of the Seismological Society of America, 108(3B), 1665-1682.